

# The flat bark beetles (Coleoptera, Silvanidae, Cucujidae, Laemophloeidae) of Atlantic Canada

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## Abstract

Eighteen species of flat bark beetles are now known in Atlantic Canada, 10 in New Brunswick, 17 in Nova Scotia, four on Prince Edward Island, six on insular Newfoundland, and one in Labrador. Twenty-three new provincial records are reported and nine species, *Uleiota debilis* (LeConte), *Uleiota dubius* (Fabricius), *Nausibius clavicornis* (Kugelann), *Ahasverus advena* (Waltl), *Cryptolestes pusillus* (Schönherr), *Cryptolestes turcicus* (Grouvelle), *Charaphloeus convexulus* (LeConte), *Charaphloeus* species nr. *adustus*, and *Placonotus zimmermanni* (LeConte) are newly recorded in the region, one of which *C. sp. nr. adustus*, is newly recorded in Canada. Eight are cosmopolitan species introduced to the region and North America, nine are native Nearctic species, and one, *Pediacus fuscus* Erichson, is Holarctic. All the introduced species except for one *Silvanus bidentatus* (Fabricius), a saproxylic species are found on various stored products, whereas all the native species are saproxylic. *Ahasverus longulus* (Blatchley) is removed from the species list of New Brunswick and *Charaphloeus adustus* (LeConte) is removed from the species list of Nova Scotia. One tropical Asian species, *Cryptamorpha desjardinsi* (Guérin-Méneville), has been intercepted in the region in imported produce, but is not established.

A substantial proportion (44%) of the fauna is comprised of introduced species, almost all of which are synanthropic, associated with various dried stored products. The island faunas of Prince Edward Island, Cape Breton Island, and insular Newfoundland are diminished in comparison to the mainland fauna, that of Prince Edward Island being exceptionally so in comparison to other saproxylic groups found there. Of the ten native species, four can be categorized as “apparently rare” (i.e., comprising  $\leq 0.005\%$  of specimens examined from the region). It is possible that the apparent scarcity of these species is related to the long history of forest management in Atlantic Canada. Further research on saproxylic faunas in the region is urged to help determine the impact that forest practices may have had and to seek measures which might lessen or ameliorate such impacts.

## Keywords

Coleoptera, Silvanidae, Cucujidae, Laemophloeidae, saproxylic beetles, new records, introduced species, stored product pests, island faunas

## Introduction

The flat bark beetles in the superfamily Cucujoidea include the Silvanidae, Passandridae, Cucujidae, and Laemophloeidae. For many years these taxa were treated as subfamilies of the Cucujidae until they were separated by Crowson (1955). They have in common their strongly dorso-ventrally flattened form. Species in the Silvaninae, Brontini, and Laemophloeidae that occur in the wild, feed on ascomycete fungi and are found under the bark of various coniferous and deciduous trees. Species in the Telephanini are found on plants, particularly withered pendant leaves, where they probably feed primarily on fungi. Other species in genera such as *Cryptolestes*, *Nausibius*, *Oryzaephilus*, and *Ahasverus* are pests of stored grains and other dried products. Species in the Cucujidae are subcortical saproxylic species that are reported to be predaceous (Thomas 2002a, 2002c, 2002d).

Thomas (2002a, 2002b, 2002c, 200d) reported approximately 1,015 species worldwide of which 90 are found in North America. Bousquet (1991), who surveyed the Canadian fauna, reported 31 species and subspecies in the country, nine of which were reported from Atlantic Canada (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and Labrador). Recent investigations of forest beetles, including Kehler et al. (1996), Dollin et al. (2008), Bishop et al. (in press), and others, have revealed that the flat bark fauna of the region is considerably more speciose than previously known. The present study reports the results of these investigations.

## Methods and conventions

Codens (following Evenhuis 2007) of collections referred to in this study are:

|             |                                                                                            |
|-------------|--------------------------------------------------------------------------------------------|
| <b>ACNS</b> | Agriculture and Agri-Food Canada, Kentville, Nova Scotia, Canada                           |
| <b>ACPE</b> | Agriculture and Agri-Food Canada, Charlottetown, Prince Edward Island, Canada              |
| <b>CBU</b>  | Cape Breton University, Sydney, Nova Scotia, Canada                                        |
| <b>CGMC</b> | Christopher G. Majka collection, Halifax, Nova Scotia, Canada                              |
| <b>CNC</b>  | Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada |
| <b>DHWC</b> | David H. Webster collection, Kentville, Nova Scotia, Canada                                |
| <b>JCC</b>  | Joyce Cook Collection, North Augusta, Ontario, Canada                                      |
| <b>JOC</b>  | Jeffrey Ogden collection, Truro, Nova Scotia, Canada                                       |
| <b>MCZ</b>  | Museum of Comparative Zoology, Cambridge, Massachusetts, United States of America          |

- MUN** Memorial University of Newfoundland collection, St. John's, Newfoundland, Canada (currently on long term loan to the Canadian Forest Service, Edmonton, Alberta)
- NBM** New Brunswick Museum, Saint John, New Brunswick, Canada
- NSAC** Nova Scotia Agricultural College, Bible Hill, Nova Scotia, Canada
- NSMC** Nova Scotia Museum, Halifax, Nova Scotia, Canada
- NSNR** Nova Scotia Department of Natural Resources, Shubenacadie, Nova Scotia, Canada
- RWC** Reginald Webster Collection, Charters Settlement, New Brunswick, Canada
- UMNB** Université de Moncton, Moncton, New Brunswick, Canada

The taxonomy and nomenclature follow Thomas (2002a, 2002b, 2002c, 2002d).

## Results

Eighteen species of flat bark beetles are now known to occur in Atlantic Canada; 10 in New Brunswick, 17 in Nova Scotia, four on Prince Edward Island, six on insular Newfoundland, and one in Labrador (Table 1). The distribution of all species (native and introduced) found in the wild is shown in Figures 1 and 2. These include eight species in the Silvanidae, two species in the Cucujidae, and eight species in the Laemophloeidae. No species of Passandridae have been found in the region although one, *Catogenus rufus* (Fabricius), does occur in neighbouring Québec. Twenty-three new provincial records are reported and nine species, *Uleiota debilis* (LeConte), *Uleiota dubius* (Fabricius), *Nausibius clavicornis* (Kugelann), *Ahasverus advena* (Waltl), *Cryptolestes pusillus* (Schönherr), *Cryptolestes turcicus* (Grouvelle), *Charaphloeus convexulus* (LeConte), *Charaphloeus* species nr. *adustus*, and *Placonotus zimmermanni* (LeConte) are newly recorded in Atlantic Canada, one of which *C. sp. nr. adustus*, is newly recorded in Canada. *Ahasverus longulus* (Blatchley) is removed from the species list of New Brunswick and *Charaphloeus adustus* (LeConte) is removed from the species list of Nova Scotia. One tropical Asian species, *Cryptamorphia desjardinsi* (Guérin-Méneville), has been intercepted in the region in imported produce, but is not established. Specific details follow.

### Silvanidae Kirby, 1837

#### Brontinae Erichson, 1845

##### Brontini Erichson, 1845

#### *Uleiota debilis* (LeConte, 1854)

**NOVA SCOTIA: Kings Co.:** Kentville, 7.VI.1996, D.H. Webster, on white ash, (1, DHWC); Kentville, 9.VI.1997, D.H. Webster, on honey locust, (1, DHWC);

Kentville, 22.V.2000, D.H. Webster, woodpile, (1, DHWC); **Lunenburg Co.:** New Ross, 20.VI.2006, M. Reeves, firewood, (1, NSNR).

*Uleiota debilis* is newly recorded in Atlantic Canada (Fig. 1). Species of Brontini are found primarily under bark where both adults and larvae probably feed on ascomycete and other fungi (Thomas 1993, 2002a). In Nova Scotia recorded from white ash (*Fraxinus americana* L., Oleaceae), and honey locust (*Gleditsia triacanthos* L., Caesalpinaceae).

*Uleiota dubius* (Fabricius, 1801)

**NOVA SCOTIA: Kings Co.:** Kentville, 1.VIII.1998, D.H. Webster, on maple, (2, DHWC); Kentville, VI.2002, C. Sheffield, in house, (1, ACNS); Cambridge Station, 7.V.1977, D.H. Webster, under bark of rotting apple, (1, DHWC).

*Uleiota dubius* is newly recorded in Atlantic Canada (Fig. 1). Species of Brontini are found primarily under bark where both adults and larvae probably feed on ascomycete and other fungi (Thomas 1993, 2002a). Common under bark of hardwoods (Downie and Arnett 1996). In Nova Scotia recorded from maple (*Acer* sp., Aceraceae), and apple (*Pyrus malus* L., Rosaceae).

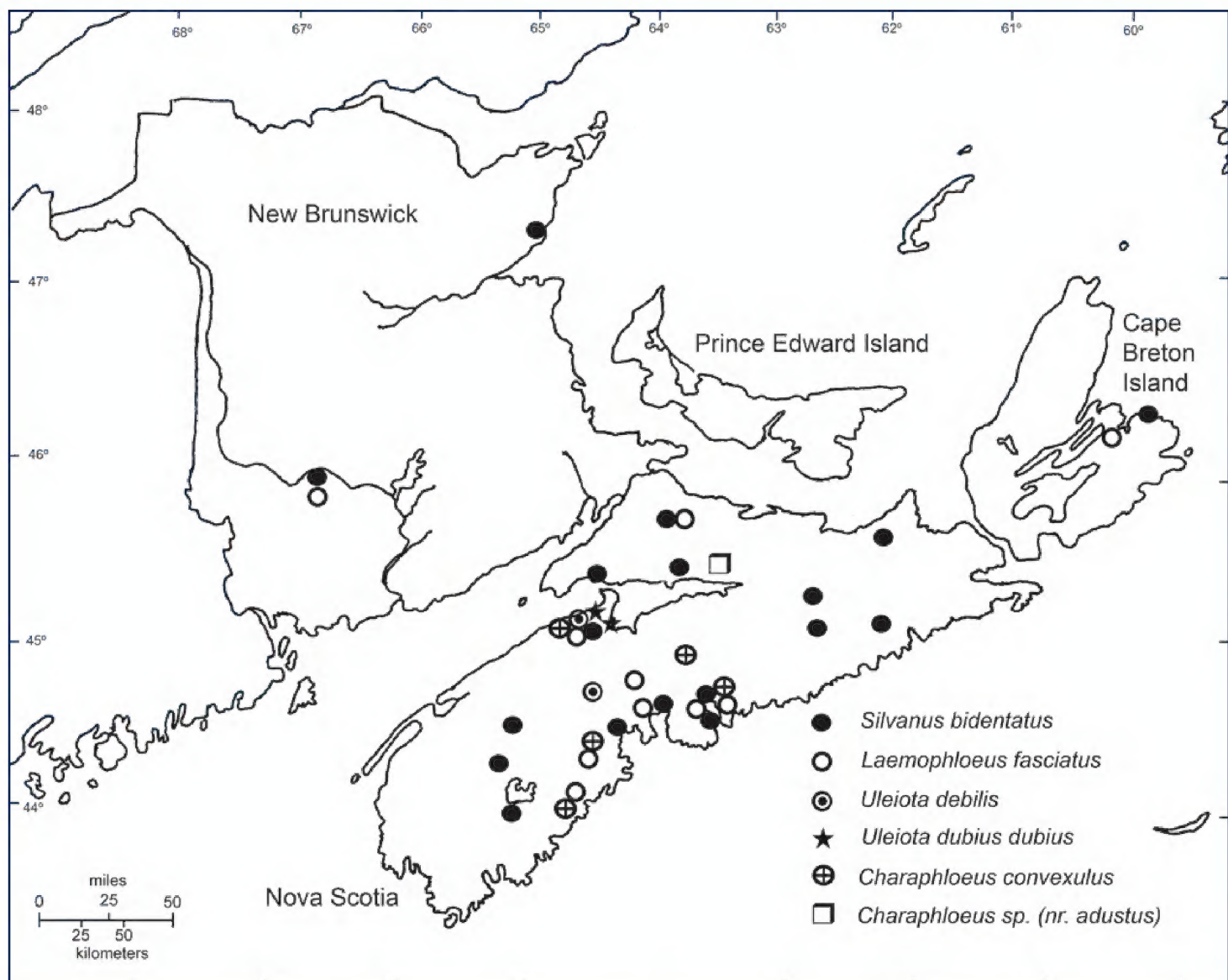


**Fig. 1.** Distribution of *Silvanus bidentatus*, *Laemophloeus fasciatus*, *Uleiota debilis*, *Uleiota d. dubius*, *Charaphloeus convexulus*, and *C. sp. nr. adustus* in Atlantic Canada.

*Dendrophagus cygnaei* Mannerheim, 1846

**NEW BRUNSWICK: Saint John Co.:** Saint John, VI.190?, W. McIntosh, (1, NBM). **NOVA SCOTIA: Antigonish Co.:** Cape George, 5.VII.1993, M. LeBlanc, (1, NSNR); **Cape Breton Co.:** Sydney, 27.IX.1991, C. Billet, (1, CBU); **Colchester Co.:** Nuttby Mt., 18.V.1995, C. Corkum, old deciduous forest, flight-intercept trap, (1, NSMC); **Cumberland Co.:** East Leicester, 3.VI.1995, C. Corkum, old deciduous forest, flight-intercept trap, (1, NSMC); Harrington River, 17.V.1995, 16.VI.1995, C. Corkum, young deciduous forest, flight-intercept trap, (3, NSMC); Moose River, 17.V.1995, C. Corkum, young deciduous forest, flight-intercept trap, (1, NSMC); **Guysborough Co.:** George Lake, 14.v-2.VI.1997, D.J. Bishop, red spruce forest, flight-intercept trap, (1, NSMC); Malay Lake, 14.V-2.VI.1997, 2-15.VI.1997, D.J. Bishop, red spruce forest, flight-intercept trap, (2, NSMC); Melopseketch Lake, 2.VI.1995, C. Corkum, young deciduous forest, flight-intercept trap, (1, NSMC); **Halifax Co.:** Big Indian Lake, 11.VI.2003, P. Dollin, red spruce forest, on bracket fungus, (1, NSMC); **Inverness Co.:** Lake Ainslie, 4.VI.1994, V. Jessome, (1, CBU); **Pictou Co.:** Lorne, 1.VI.1995, C. Corkum, old coniferous forest, flight-intercept trap, (1, NSMC); **Queens Co.:** Butler Rd. 21.V.2004, P. Colp, (1, NSNR); Sixth Lake, 19.V.2003, P. Dollin, old growth hemlock forest, (1, NSMC).

*Dendrophagus cygnaei* is newly recorded in New Brunswick and Nova Scotia (Fig. 2). It was recorded from Newfoundland by Bousquet (1991). Species of Brontini are found primarily under bark where both adults and larvae probably feed on ascomycete and other fungi (Thomas 1993, 2002a). In Nova Scotia recorded from a wide variety of coniferous and deciduous forests.

**Telephanini LeConte, 1861**

*Cryptamorphia desjardinsi* (Guérin-Méneville, 1844)

**NOVA SCOTIA: Kings Co.:** Kentville, 22.III.2002, D.H. Webster, in imported bok choy, (1, DHWC).

In Nova Scotia *Cryptamorphia desjardinsi* was intercepted in bok choy, probably imported from the United States. There is no evidence that the species is established. This species is native to tropical Asia and is now established in Florida and Alabama in the United States (Thomas 1993, 2002a). It is associated with plant molds and is found in sugarcane sheathes, on palmettos, on bananas, pineapples, and similar plants. Adults and larvae feed on sugarcane smut, *Ustilago scitaminea* Syd. (Thomas 1993).

## Silvaninae, Kirby, 1837

*Nausibius clavicornis* (Kugelann, 1794)

**NEW BRUNSWICK: Saint John Co.:** Saint John, 9.VII.1902, 8.VII.1903, W. McIntosh, (2, NBM). **NOVA SCOTIA: Lunenburg Co.:** Chester, 17.VII.1968, B. Wright, (1, NSMC).

*Nausibius clavicornis* is newly recorded in Atlantic Canada. Originally a Neotropical species it is now cosmopolitan. Originally subcorticolous (and also reported from old bees' nests) in the field, it is now a pest of stored products, particularly raw or yellow-crystal sugar. It has also been reported from rice, dried apples, ginger, and cassia (Thomas 1993).

*Oryzaephilus mercator* (Fauvel, 1889)

**PRINCE EDWARD ISLAND: Queens Co.:** Charlottetown, 23.IV.1985, L.S. Thompson, in house, (3, ACPE).

*Oryzaephilus mercator* is newly recorded in Prince Edward Island. It was reported from New Brunswick, Nova Scotia, and insular Newfoundland by Bousquet (1991). This cosmopolitan species is one of the most common household pests in Canada.

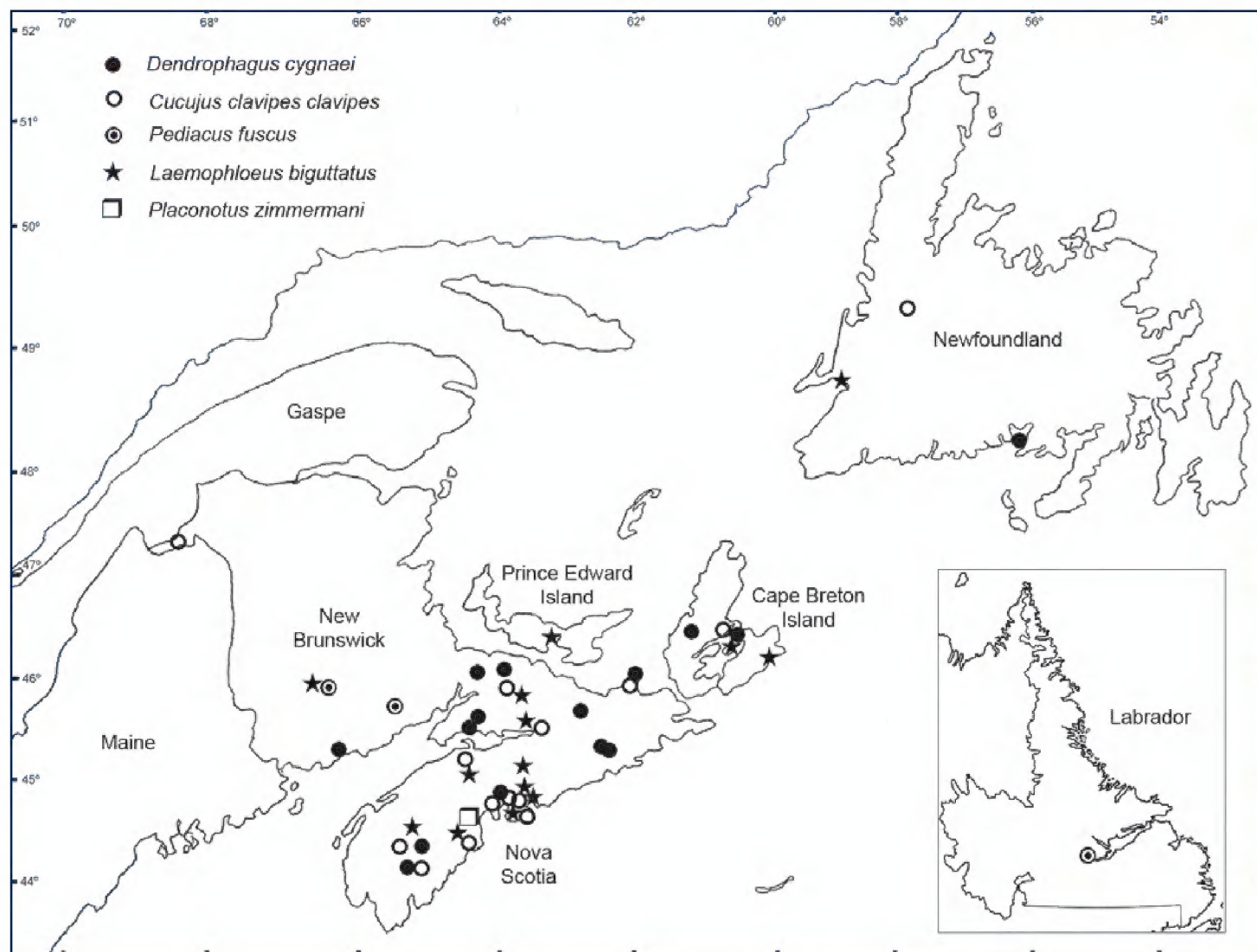


**Fig. 2.** Distribution of *Dendrophagus cygnaei*, *Cucujus c. clavipes*, *Pediacus fuscus*, *Laemophloeus biguttatus*, and *Placonotus zimmermanni* in Atlantic Canada. Inset map shows records from Labrador.

Adults and larvae feed primarily on cereal products, particularly oatmeal, bran, shelled sunflower seeds, rolled oats, and brown rice (Bousquet 1990).

*Oryzaephilus surinamensis* (Linnaeus, 1758)

**NEW BRUNSWICK: Saint John Co.:** Saint John, 5.IX.1902, IX.190?, W. McIntosh, (2, NBM). **NEWFOUNDLAND:** Ferryland (Prévost and Bain 2007). **NOVA SCOTIA: Inverness Co.:** Cheticamp, 11.III.2005, H. David, in house, (1, NSMC); **Kings Co.:** Kentville, 29.IX.1960, Mrs. W.R.C., (12, NSAC); Wolfville, 19.III.1960, H.T. Stultz, storage room, (1, ACNS); **Lunenburg Co.:** Bridgewater, 29.VII.2002, V. Oakley, stored food, (6, NSNR); **Pictou Co.:** Lyons Brook, 23.IV.1996, E. Georgeson, stored grains, (1, NSNR).

*Oryzaephilus surinamensis* is newly recorded in New Brunswick and Nova Scotia. The records from Newfoundland (Prévost and Bain 2007) are from archeological excavations of a latrine from deposits dated from approximately 1620. This cosmopolitan species is a serious pest of stored grain found primarily in granaries, grain elevators, and flour mills. Adults and larvae attack both damaged grain and processed cereals (Bousquet 1990). It is also found on dried fruit, copra, nuts, and carob (Thomas 1993). Unlike *O. mercator*, it can survive Canadian winter conditions in unheated premises (Bousquet 1990).

*Silvanus bidentatus* (Fabricius, 1792)

**NOVA SCOTIA: Annapolis Co.:** Durland Lake, 21.VI.2003, P. Dollin, eastern hemlock/balsam fir/black spruce forest, (1, NSMC); **Cape Breton Co.:** New Waterford, 16.IX.1993, T.N. Kanne, (1, CBU); Colchester Co.: 3.VI.1995, C. Corkum, old deciduous forest, flight-intercept trap, (1, NSMC); **Cumberland Co.:** Diligent River, 27.VII.1988, E. Georgeson, UV light trap, (1, NSMC); Oxford, 9.VIII.1988, E. Georgeson, UV light trap, (1, NSMC); **Guysborough Co.:** Malay Lake, 2-15.VI.1997, D.J. Bishop, red spruce forest, flight-intercept trap, (1, NSMC); Trafalgar, 19.VII.1992, S. and J. Peck, car net, (1, JCC); **Halifax Co.:** Abraham's Lake, 2-15.VI.1997, 15-30.VI.1997, 1-16.VII.1997, D.J. Bishop, old-growth red spruce forest, flight-intercept trap, (4, NSMC); Bedford, 22.VIII.1988, B. Pothier, (1, NSMC); Big St. Margaret's Bay, 15-30.VI.1997, D.J. Bishop, old-growth red spruce forest, flight-intercept trap, (1, NSMC); Halifax, 29.VII.1991, R. Stuart, (12, NSMC); Point Pleasant Park, 1.IX.2000, 9.IX.2000, 10.VIII.2001, 2.VI.2002, 9.VI.2002, 18.VI.2002, 22.IX.2002, coniferous forest, under bark of *Picea rubens* and *Pinus strobus*, (14, CGMC); **Kings Co.:** Kentville, 1.VIII.1998, D.H. Webster, on maple, (2, DHWC); Lunenburg Co.: Chester, 6.VI.1968, 8.VI.1968, B. Wright, (2, NSMC); **Pictou Co.:** Marshy Hope, 23.VI.1994, M. LeBlanc, (1, JOC); Marshy Hope, 9.VI.1995, M. LeBlanc, (1, NSNR); **Queens Co.:** Kejimikujik National Park, 16.VI.2004, M. LeBlanc, flight-intercept trap, (1, NSNR); Sixth Lake, 18.VI.2003, P. Dollin, old-growth hemlock forest, on red spruce log, (1, NSMC).

This introduced Palearctic species is newly recorded in Nova Scotia (Fig. 1). Bousquet (1991) reported it from New Brunswick. Species of *Silvanus* are found under the bark of logs and dead trees where they are at least partly fungivorous (Thomas 1993). In Nova Scotia they have most frequently been found in coniferous forests, under the bark of red spruce (*Picea rubens* Sarg.) and white pine (*Pinus strobus* L.) (Pinaceae) and on maple (*Acer* sp.).

*Ahasverus advena* (Waltl, 1832)

**NOVA SCOTIA: Halifax Co.:** Halifax, 14.IX.1992, C. Stevens, (8, NSMC); Halifax, 13.XI.1986, D. McCarthy, (2, NSMC); Halifax, 1.IX.1989, R. White, (1, NSMC); Halifax, 12.I.1990, collector not recorded, (1, NSMC); Halifax, 9.VII.1991, K. Anthony, (4, NSMC); **Kings Co.:** Kentville, 10.VIII.2005, D.H. Webster, compost heap, on moldy corncobs, (1, DHWC); locality and collector not recorded, (8, NSAC). **PRINCE EDWARD ISLAND: Queens Co.:** Charlottetown, IX.1984, L.S. Thompson, (1, ACPE).

*Ahasverus advena* is newly recorded in Atlantic Canada. This is a cosmopolitan species that feeds on surface molds such as *Penicillium glaucoma* and *Aspergillus* sp. It has been associated with moldy copra, lima beans, pigeon peas, stored grain, fruit, nuts, corn, dried pears, cereals, on damp flour, rice, figs, and apples, in coffee beans, moldy grass, on cured ham and stored oats and decaying soybeans (Thomas 1993).

*Ahasverus longulus* (Blatchley, 1910)

No voucher specimens were found in any collection examined and there are no published records of the species from New Brunswick. It was included in Bousquet's (1991) checklist, but it was not recorded from there by Thomas (1993) and M. Thomas (pers. comm.) has no records of the species occurring there. Consequently this species is removed from the faunal list of New Brunswick.

## Cucujidae Latreille, 1802

*Cucujus clavipes clavipes* Fabricius, 1781

**NEW BRUNSWICK: Madawaska Co.:** Caron Brook, 10.IX.1999, P. Godin, (1, UMNb); Caron Brook, 11.IX.1999, S. Cormier, (1, UMNb).

*Cucujus c. clavipes* is newly recorded in New Brunswick. It was recorded from Nova Scotia and insular Newfoundland by Bousquet (1991) (Fig. 2). Adults and larvae are found under the bark of dead trees. Larvae are apparently predaceous (Thomas 2002c).

*Pediacus fuscus* Erichson, 1845

This Holarctic species was recorded from both New Brunswick and Labrador by Bousquet (1991) (Fig. 2). In the Old World the species is found in Estonia, Finland, Latvia, Sweden, northern Russia, and Siberia (Slipinski 2007). In North America they have been recorded from Alaska, the Northwest Territories and British Columbia east across Canada to Labrador and in the United States from Colorado, Maine, Michigan, New Hampshire, and Wisconsin (Thomas 2004). Species in the genus *Pediacus* are predominantly found under the bark of dead conifers (Thomas 2004). In Latvia several specimens were collected under the bark of Scotch pine (*Pinus sylvestris* L., Pinaceae) (Telnov et al. 2007; D. Telnov pers. comm.).

**Laemophloeidae Ganglbauer, 1899**

**Laemophloeinae Ganglbauer, 1899**

*Cryptolestes ferrugineus* (Stephens, 1831)

**NOVA SCOTIA: Colchester Co.:** Truro, 15.II.1973, G. Townsend, (4, NSAC); **Halifax Co.:** Halifax, 4.XII.1989, (1, NSMC); Halifax, 1.XII.1999, R. White, grain elevators, (6, NSMC); locality not recorded, 27.VI.1973, collector not recorded, (25, NSAC). **PRINCE EDWARD ISLAND: Queens Co.:** Charlottetown, 16.IV.1985, J. Lund, in barley, (2, ACPE); Charlottetown, VIII.1992, J.G. Stewart, grain bin, (3, ACPE).

*Cryptolestes ferrugineus* is newly recorded in Nova Scotia and Prince Edward Island. It was reported from Newfoundland by Bousquet (1991). This cosmopolitan species is a serious pest of stored grain in Canada where it is found mainly in granaries, grain elevators, and mills (Bousquet 1990).

*Cryptolestes pusillus* (Schönherr, 1817)

**NEW BRUNSWICK: Albert Co.:** Mary's Point, 19.X.1988, D.S. Christie, (1, NBM); **NOVA SCOTIA: Colchester Co.:** Bible Hill, 1.V.1996, J. Ogden, (12, NSNR, JOC); **Halifax Co.:** Halifax, 2.XI.1989, 1.XII.1999, 10.XII.1999, R. White, (21, NSMC); **Pictou Co.:** Lyons Brook, 23.IV.1996, E. Georgeson, (1, NSNR).

*Cryptolestes pusillus* is newly recorded in Atlantic Canada. This cosmopolitan species is found mainly in grain elevators and flour mills where it feeds on damaged grain, preferably wheat (Bousquet 1990).

*Cryptolestes turcicus* (Grouvelle, 1876)

**NOVA SCOTIA: Halifax Co.:** Dartmouth, 25.XI.1986, D.S. Davies, (17, NSMC); Halifax, 15.IX.2004, K. Batherson, flour warehouse, (5, NSMC).

*Cryptolestes turcicus* is newly recorded in Atlantic Canada. This cosmopolitan species is found in feed and flour mills, grain elevators, and warehouses where it feeds on fungi growing on damaged grains (Bousquet 1990).

*Laemophloeus biguttatus* (Say, 1825)

*Laemophloeus biguttatus* is widely distributed in New Brunswick, Newfoundland, Nova Scotia, and Prince Edward Island (Bousquet 1991) (Fig. 2). They are found under the bark of trees where they feed on ascomycete fungi such as *Hypoxylon* prob. *atropunctatum* (Schweinitz ex Fries) Cooke (Thomas 1993). In Nova Scotia it has been collected in coniferous and mixed forests on both red maple (*Acer rubrum* L., Aceraceae) and red oak (*Quercus rubra* L., Fagaceae).

*Laemophloeus fasciatus* Melsheimer, 1846

**NEW BRUNSWICK: York Co.:** New Maryland, 20.VI.2003, R.P. Webster, mixed forest, at light, (1, RWC). **NOVA SCOTIA: Cape Breton Co.:** George's River, 15.VI.2000, D.B. McCorquodale, (1, CBU); **Cumberland Co.:** Oxford, 14.VI.1988, 17.VI.1988, 7.VII.1988, 19.IX.1988, E. Georgeson, UV light rap, (4, NSMC); **Halifax Co.:** Dartmouth, 29.VIII.1990, S. Marr, (1, NSMC); Halifax, 24.IX.1991, E. Boutilier, (3, NSMC); Halifax, 3.X.1991, S. Harrie, (1, NSMC); Hubbards, 3.X.1989, J. Barkhouse, (1, NSMC); **Hants Co.:** Panuke Lake, 2-15.VI.1997, D.J. Bishop, old growth eastern hemlock-red spruce forest, flight-intercept trap, (1, NSMC); **Kings Co.:** Kentville, 3.VIII.1998, D.H. Webster, on basswood, (1, DHWC); **Lunenburg Co.:** 19.VI.1965, B. Wright, (1, NSMC); **Queens Co.:** Medway River, 13.VII.1993, J. & T. Cook, car net, (2, JCC).

*Laemophloeus fasciatus* is newly recorded in Atlantic Canada (Fig. 1). It is found under bark (Thomas 1993). In Atlantic Canada it has been collected in coniferous and mixed forests and has been found on basswood (*Tilia europea* L., Tiliaceae).

*Charaphloeus adustus* (LeConte, 1854)

*Charaphloeus adustus* was reported from Nova Scotia by Bousquet (1991). Subsequent examination of the specimen in the CNC has established that it is actually *C. convexulus*. Consequently this species is removed from the faunal list of Nova Scotia.

*Charaphloeus convexulus* (LeConte, 1879)

**NOVA SCOTIA: Halifax Co.:** Halifax, VI.1897, J.D. Evans, Evans (1899); Waverley, 14.V.1965, B. Wright, window trap in red oak, (1, NSMC); **Hants Co.:** Mount Uniacke, 16.VI.1947, W.J. Brown, (1, CNC); **Kings Co.:** Aldershot, 15.V.1950, H.T. Stultz, (1, ACNS); **Lunenburg Co.:** Bridgewater, 12.V.1965, 27.V.1965, 19.VI.1965, 30.VI.1965, 16-19.V.1965, 10-14.V.1965, B. Wright, window trap in red oak, (6, NSMC); **Queens Co.:** Medway River, 13.VII.1993, J. and T. Cook, car net, (1, JCC).

*Charaphloeus convexulus* is newly recorded in Atlantic Canada (Fig. 1). Although species was originally reported from Halifax, Nova Scotia by Evans (1899), subsequent authors have overlooked this early record. Found under bark (Thomas 1993).

*Charaphloeus* undescribed species (nr. *adustus*)

**NOVA SCOTIA: Colchester Co.:** Debert, 25.VII.1996, J. Ogden, (1, NSNR).

This undescribed species is newly recorded in Canada (Fig. 1). Blatchley (1910) reported this species on beech (*Fagus grandifolia* Ehrh., Fagaceae) logs (Thomas 1993). This undescribed species can be identified with the keys in Downie and Arnett (1996: 1001).

*Placonotus zimmermanni* (LeConte, 1854)

**NOVA SCOTIA: Lunenburg Co.:** 30.VI.1965, B. Wright, red oak, window trap, (1, NSMC).

*Placonotus zimmermanni* is newly recorded in Atlantic Canada (Fig. 2). Thomas (1993) collected this species under the bark of dead hardwoods, especially oaks (*Quercus* spp.) on or near ascomycete fungi. In Nova Scotia it was collected on red oak (*Quercus rubra*).

## Discussion

Of the 18 species recorded in the region, eight are adventive cosmopolitan species introduced to the region and North America. Ten are native Nearctic species, and one, *Pediacus fuscus*, is Holarctic. All the introduced species except for *Silvanus bidentatus* (a saproxylic species) are found on various stored products, whereas all the native species are saproxylic (Table 1). One tropical Asian species, *Cryptamorpha desjardinsi*, has been intercepted in imported produce, but is not established here.

Even with the substantial increases in the known fauna of the region (nine new species and 23 new provincial records) it is probable, given the relatively modest collecting effort devoted to this group of beetles in Atlantic Canada, that more species remain to be found. Six additional species have been recorded in Québec and two others in Maine (Bousquet 1991; Chandler 2001), all of which could potentially occur in Atlantic Canada. Although *Ahasverus longulus* has been removed from the New Brunswick faunal list, it has been recorded in Québec and should be looked for in the region.

A substantial proportion of species (44%) are introduced, similar to the 46% of non-native Bostrichiformia (Derodontidae, Dermestidae, Bostrichidae, and Anobiidae) in the Maritime Provinces (New Brunswick, Nova Scotia, and Prince Edward Island) (Majka 2007a). This is almost triple the proportion (15.3%) of introduced Coleoptera in the region overall (C.G. Majka, unpublished data). Seven of these eight species are synanthropic, associated with various dried, stored products. The earliest North

**Table 1.** The number of county records of Silvanidae, Cucujidae, and Laemophloeidae in Atlantic Canada

|                                                      | NB | NS | PE | NF | LB | Bio-nomics | Regional Distribution                      |
|------------------------------------------------------|----|----|----|----|----|------------|--------------------------------------------|
| <b>SILVANIDAE</b>                                    |    |    |    |    |    |            |                                            |
| <b>Brontinae</b>                                     |    |    |    |    |    |            |                                            |
| <i>Uleiota debilis</i> (LeConte)                     |    | 2  |    |    |    | SX         | ME, NH, NS, NY, ON, QC, RI                 |
| <i>Uleiota dubius</i> (Fabricius)                    |    | 1  |    |    |    | SX         | NH, NS, NY, ON, QC, RI                     |
| <i>Dendrophagus cygnaei</i> Mannerheim               | 1  | 9  |    | 1  |    | SX         | ME, NB, NF, NH, NS, NY, ON, QC             |
| <b>Silvaninae</b>                                    |    |    |    |    |    |            |                                            |
| <i>Nausibius clavicornis</i> (Kugelann) †            | 1  | 1  |    |    |    | SP         | NB, NS, ON, QC                             |
| <i>Oryzaephilus mercator</i> (Fauvel) †              | 2  | 6  | 1  | 1  |    | SP         | ME, NB, NF, NH, NS, ON, PE, QC             |
| <i>Oryzaephilus surinamensis</i> (Linnaeus) †        | 1  | 4  |    | 1  |    | SP         | MA, ME, NB, NF, NH, NS, ON, QC, RI         |
| <i>Silvanus bidentatus</i> (Fabricius) †             | 2  | 10 |    |    |    | SX         | ME, NB, NF, NH, NS, NY, ON, QC, RI         |
| <i>Ahasverus advena</i> (Waltl) †                    |    | 2  | 1  |    |    | SP         | MA, ME, NH, NS, ON, PE, QC                 |
| <b>CUCUJIDAE</b>                                     |    |    |    |    |    |            |                                            |
| <i>Cucujus clavipes clavipes</i> Fabricius           | 1  | 8  |    | 1  |    | SX         | MA, ME, NB, NF, NH, NS, ON, QC, RI         |
| <i>Pediacus fuscus</i> Erichson *                    | 2  |    |    |    | 1  | SX         | LB, ME, NB, ON, QC                         |
| <b>LAEMOPHLOEIDAE</b>                                |    |    |    |    |    |            |                                            |
| <b>Laemophloeinae</b>                                |    |    |    |    |    |            |                                            |
| <i>Cryptolestes ferrugineus</i> Stephens †           |    | 2  | 1  | 1  |    | SP         | NF, NS, ON, QC, PE                         |
| <i>Cryptolestes pusillus</i> (Schönherr) †           | 1  | 3  |    |    |    | SP         | ME, NB, NF, NS, ON, QC                     |
| <i>Cryptolestes turcicus</i> (Grouvelle) †           |    | 1  |    |    |    | SP         | NH, NS, ON, QC                             |
| <i>Laemophloeus biguttatus</i> (Say)                 | 1  | 7  | 1  | 1  |    | SX         | MA, ME, NB, NF, NH, NS, NY, ON, QC, PE, RI |
| <i>Laemophloeus fasciatus</i> Melsheimer             | 1  | 7  |    |    |    | SX         | MA, ME, NB, NH, NS, NY, ON, QC, RI         |
| <i>Charaphloeus convexulus</i> (LeConte)             |    | 5  |    |    |    | SX         | MA, ME, NH, NS, NY, ON, RI                 |
| <i>Charaphloeus</i> undescribed species              |    | 1  |    |    |    | SX         | ME, NH, NS                                 |
| <i>Placonotus zimmermanni</i> (LeConte)              |    | 1  |    |    |    | SX         | ME, NS, NY, ON, QC, RI, VT                 |
| Total counties                                       | 13 | 69 | 4  | 6  | 1  |            |                                            |
| Total species                                        | 10 | 17 | 4  | 6  | 1  |            |                                            |
| <b>Intercepted Silvanidae</b>                        |    |    |    |    |    |            |                                            |
| <i>Cryptamorpha desjardinsi</i> (Guérin-Méneville) § |    | 1  |    |    |    |            | NH, NS, NY                                 |

**Notes:** NB, New Brunswick; NS, Nova Scotia; PE, Prince Edward Island; NF, insular Newfoundland; LB, Labrador. Numbers indicate the number of county records. There are 15 counties in New Brunswick, 18 in Nova Scotia, and 3 on Prince Edward Island. County divisions are not employed in the province of Newfoundland and Labrador so numbers from there simply indicate the presence of species. SP, Stored Product species; SX, Saproxylic species; †, adventive Palearctic species; \*, Holarctic species; §, adventive Asian species.

**Regional Distribution:** For the purposes of this treatment, northeastern North America is taken to include of the following jurisdictions: CT, Connecticut; LB, Labrador; MA, Massachusetts; ME, Maine; NB, New Brunswick; NF, insular Newfoundland; NH, New Hampshire; NY, New York; ON, Ontario; PE, Prince Edward Island; PM, Saint-Pierre et Miquelon; QC, Québec; RI, Rhode Island; VT, Vermont. Distributional data is compiled from Bousquet (1991), Chandler (2001), Dearborn and Donahue (1993), Downie and Arnett (1996), Sikes (2004), and the present study.

America date of detection (1620) of one, *Oryzaephilus surinamensis*, is from this region, from specimens excavated from a latrine in Newfoundland (Prévost and Bain 2007) (Table 2). Early dates of detection of these introduced species in Atlantic Canada (mean = 1916) are substantially later than in North America as a whole (mean = 1794), probably as a result of a lack of early collecting in this region. In contrast to many adventive terricolous beetles, a large number of which were introduced to North America in association with dry ballast imported to Atlantic Canadian ports (Lindroth 1957), most of

**Table 2.** Earliest dates of detection of introduced Silvanidae and Laemophloeidae in Atlantic Canada

|                                             | NB          | NS          | PE          | NF          | NA   | Source                  |
|---------------------------------------------|-------------|-------------|-------------|-------------|------|-------------------------|
| <b>SILVANIDAE</b>                           |             |             |             |             |      |                         |
| <i>Nausibius clavicornis</i> (Kugelann)     | <b>1902</b> | 1968        |             |             | 1670 | Bain (1998)             |
| <i>Oryzaephilus mercator</i> (Fauvel)       | 1971        | <b>1954</b> | 1985        | 1962        | 1670 | Bain (1998)             |
| <i>Oryzaephilus surinamensis</i> (Linnaeus) | 1902        | 1960        |             | <b>1620</b> | 1620 | Prévost and Bain (2007) |
| <i>Silvanus bidentatus</i> (Fabricius)      | <b>1928</b> | 1968        |             |             | 1910 | Blatchley (1910)        |
| <i>Ahasverus advena</i> (Waltl)             |             | 1986        | <b>1984</b> |             | 1860 | Bain (1999)             |
| <b>LAEMOPHLOEIDAE</b>                       |             |             |             |             |      |                         |
| <i>Cryptolestes ferrugineus</i> Stephens    |             | 1973        | 1985        | <b>1965</b> | 1884 | Casey (1884)            |
| <i>Cryptolestes pusillus</i> (Schönherr)    | <b>1988</b> | 1989        |             |             | 1854 | LeConte (1854)          |
| <i>Cryptolestes turcicus</i> (Grouvelle)    |             | <b>1986</b> |             |             | 1884 | Casey (1884)            |

**Notes:** NB, New Brunswick; NS, Nova Scotia; PE, Prince Edward Island, NF, insular Newfoundland; NA, North America. Boldface entries signify the earliest dates for a species in the region.

the introduced flat bark beetles are stored product pests introduced to the continent via other mechanisms. One introduced species, *Silvanus bidentatus*, is corticolous, has successfully colonized native habitats, and is now widely-distributed in North America.

As is typically the case with islands, the species richness of the native faunas of Prince Edward Island, Cape Breton Island, and insular Newfoundland are diminished in comparison with that of the neighbouring mainland (Table 3). This may represent an island-associated diminution, a paucity of collecting, an area effect, or a combination of these factors. The fauna of Cape Breton is 40% that of the combined Atlantic Canadian native fauna, that of insular Newfoundland is 30%, and that of Prince Edward Island is 10%. Majka (2007b) reported comparable numbers for 283 native saproxylic species in 18 families, subfamilies and tribes. The overall mean of these numbers on Cape Breton Island was 33% and on insular Newfoundland it was 28%, very similar to the proportions of flat bark beetles. On Prince Edward Island the overall mean was 30%, substantially greater than the 10% of flat bark beetles found on PEI. Either the flat bark beetle fauna of Prince Edward Island is smaller than might otherwise be expected, or else collecting effort there has been insufficient to fully discern the fauna.

Although Labrador is located on the North American mainland it also has an impoverished flat bark beetle fauna consisting solely of the Holarctic species, *Pediacus fuscus*. In part this reflects the fact that substantial portions of Labrador consist of barrens, bogs, sub-arctic, low arctic, and alpine tundra that lack trees and are unsuitable for bark beetles. Furthermore the boreal forests that are found in Labrador are dominated by conifers such as black spruce (*Picea mariana* (Mill.) BSP) and balsam fir (*Abies balsamea* (L.) Mill, Pinaceae) with only a modest component of deciduous trees such as trembling aspen (*Populus tremuloides* Michx., Salicaceae) and white birch (*Betula papyrifera* Marshall, Betulaceae) (Anonymous 2003). Most flat bark beetles (with the exception of *P. fuscus*), however, are associated largely or exclusively on hardwoods. *Pediacus fuscus* is the only flat bark beetle found in the Yukon Territory, and only it and *Cathartosilvanus imbellis* (LeConte) have been recorded in the Northwest Territories – two other northern jurisdictions dominated by boreal coniferous forests.

**Table 3.** Numbers and proportions of native flat bark beetle species on islands in Atlantic Canada

|                | AC | PE      | CB      | NF      |
|----------------|----|---------|---------|---------|
| Silvanidae     | 3  | 0       | 1       | 1       |
| Cucujidae      | 2  | 0       | 1       | 1       |
| Laemophloeidae | 5  | 1       | 2       | 1       |
| Total          | 10 | 1 (10%) | 4 (40%) | 3 (30%) |

**Notes:** AC, Atlantic Canada; PE, Prince Edward Island; CB; Cape Breton Island; NF, insular Newfoundland

Majka (2007b) drew attention to the substantial number of “apparently rare” native saproxylic species found in Atlantic Canada (defined as those comprising  $\leq 0.005\%$  of specimens examined from the region). He drew attention to 59 such species from 14 families of beetles that represented 33% of the species in these taxa that fell into the category of “apparently rare.” Amongst the flat bark beetles, four of the 10 native species including *Uleiota debilis*, *Uleiota dubius*, *Charaphloeus* sp. (nr. *adustus*), and *Placonotus zimmermanni* all fall into this category, and all are associated with hardwoods. Majka (2007b) suggested that the large number of apparently rare species could be related to the long history of forest management practices. For instance, in Nova Scotia although 78% of the land base is forested, less than 1% of that land is composed of old-growth forests (Loo and Ives 2003). Short-rotation, monoculture plantation, forestry practices that have emphasized coniferous trees for fibre production have contributed to an impoverishment of forest diversity, particularly that of long-maturing hardwood forests. It is not unreasonable to suppose that such practices have had a corresponding impact on the invertebrate faunas found in the forests of Atlantic Canada. The most abundant saproxylic species in the region is the introduced *Silvanus bidentatus*, which is principally associated with coniferous trees.

Alexander (2004) draws attention to beetles in Great Britain that are associated with undisturbed forests. Six of the 180 species of beetles used to calculate the Index of Ecological Continuity (an inverse of disturbance) are flat bark beetles including *Silvanus bidentatus*, *Silvanus unidentatus* (Olivier), *Uleiota planata* (Linnaeus), *Pediacus depressus* (Herbst), *Pediacus dermestoides* (Fabricius), and *Notolaemus unifasciatus* (Latreille) (representing three of the genera found in Atlantic Canada), an indication that some flat-bark beetles are very susceptible to disturbance. With respect to European saproxylics, Grove (2002: 14-15) wrote that, “Many saproxylic species now survive ... only as relictual populations, ‘hanging on by the tips of their tarsi’ ... In the absence of positive management, the ultimate extinction of some such species (truly the ‘living dead’) is almost inevitable through stochastic events”. Further research needs to be done in Atlantic Canada to determine the impact that forest history and current practices may have had on saproxylic species such as flat bark beetles, and measures which might lessen or ameliorate habitat fragmentation, the disappearance of old-growth forests, and the diminution of coarse woody debris – all parameters of forests significant to this functional group of beetles.

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## References

- Alexander KNA (2004) Revision of the Index of Ecological Continuity as used for saproxylic beetles. Research Report 574, English Nature, Peterborough, 60 pp.
- Anonymous (2003) Provincial Sustainable Forest Management Strategy. Appendix 5: Ecoregion Descriptions of Newfoundland and Labrador. St. John's, Newfoundland: Forest Service of Newfoundland and Labrador, 99-104. <http://www.nr.gov.nl.ca/forestry/publications/appendix5.pdf> [accessed 28.VII.2008]
- Bain A (1998) A seventeenth-century beetle fauna from colonial Boston. *Historical Archeology* 32(3): 38-48.
- Bain A (1999) Archeoentomological and archeoparasitological reconstructions at Îlot Hunt (CeEt-110): new perspectives in historical archeology (1850-1900). Ph.D. thesis, University of Laval, Québec, 310 pp.
- Bishop DJ, Majka CG, Bondrup-Nielsen S, Peck SB (in press) Deadwood and saproxylic beetle diversity in naturally disturbed and managed spruce forests in Nova Scotia. *Forest Ecology and Management*.
- Blatchley WS (1910) An illustrated descriptive catalogue of the Coleoptera or Beetles (exclusive of the Rhynchophora) known to occur in Indiana. The Nature Publishing Company, Indianapolis, 1386 pp.
- Bousquet Y (1990) Beetles associated with stored products in Canada: an identification guide. Agriculture Canada Publication 1837: 1-215
- Bousquet Y (1991) Family Cucujidae: flat bark beetles. In: Bousquet Y (Ed) Checklist of Beetles of Canada and Alaska. Agriculture Canada Publication 1861/E: 219-220.
- Casey TL (1884) Revision of the Cucujidae of America North of Mexico. *Transactions of the American Entomological Society* 11: 69-112.
- Chandler DS (2001) University of New Hampshire Insect and Arachnid Collections. <http://colsa1.unh.edu:591/unhinsects.htm> [accessed 28.VII.2008]
- Crowson RA (1955) The natural classification of the families of Coleoptera. Nathaniel Lloyd, London, 187 pp.
- Dearborn RG, Donahue CP (1993) An annotated list of insects collected and recorded by the Maine Forest Service: Order Coleoptera, Beetles. Augusta, Maine: Insect and Disease Division of the Maine Forest Service. Department of Conservation Technical Report 32: 1-102.
- Dollin PE, Duinker PN, Majka CG (2008) Saproxylic beetle (Coleoptera) communities and forest management practices in coniferous stands in southwest Nova Scotia, Canada. In: Majka C, Klimaszewski J (Eds) Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. *ZooKeys* 2.

- Downie NM, Arnett RH, Jr. (1996) The Beetles of Northeastern North America, Volumes 1 and 2. Sandhill Crane Press, Gainesville, 1721 pp.
- Evans JD (1899) List of Coleoptera from Halifax, NS. *The Canadian Entomologist* 31: 320-321.
- Evenhuis NL (2007) Abbreviations for insect and spider collections of the world. <http://hbs.bishopmuseum.org/codens/codens-inst.html> [accessed 28.VII.2008]
- Grove SJ (2002) Saproxylic insect ecology and the sustainable management of forests. *Annual Review of Ecology and Systematics* 33: 1-23.
- Kehler D, Corkum C, Bondrup-Nielsen S (1996) Habitat Associations and Species Diversity of Forest Beetle Communities of Nova Scotia. Centre for Wildlife and Conservation Biology, Acadia University, Wolfville, 120 pp.
- LeConte JL (1854) Synopsis of the Cucuiides of the United States. *Proceedings of the Academy of Natural Sciences of Philadelphia* 7: 73-79.
- Leng CW (1920) Catalogue of the Coleoptera of America north of Mexico. John D. Sherman, Jr., Mount Vernon, New York, 470 pp.
- Lindroth CH (1957) The faunal connections between Europe and North America. Almqvist & Wiksell, Stockholm, 344 pp.
- Loo J, Ives N (2003) The Acadian forest: historical condition and human impacts. *The Forestry Chronicle* 79: 462-472.
- Majka CG (2007a) The Derodontidae, Dermestidae, Bostrichidae, and Anobiidae of the Maritime Provinces of Canada (Coleoptera: Bostrichiformia). *Zootaxa* 1573: 1-38.
- Majka CG (2007b) The Eucnemidae (Coleoptera) of the Maritime Provinces of Canada: new records, observations on composition and zoogeography, and comments on the scarcity of saproxylic beetles. *Zootaxa* 1636: 33-46.
- Prévost M-A, Bain A (2007) L'implantation d'une colonie terre-neuvienne au XVIIe siècle: l'apport des analyses archéobotanique et archéontomologique. In: Bain A, Chabot J, Moussette M (Eds) *La mesure du passé: contributions à la recherche en archéométrie (2000-2006)*. British Archaeological Reports. International Series number 1700. Archaeopress, Oxford, 205-216.
- Sikes DS (2004) The beetle fauna of Rhode Island: an annotated checklist, Volume 3. Rhode Island Natural History Survey, Kingston, 296 pp.
- Slipinski A. (2007) *Pediacus fuscus* Erichson 1845. In: *Fauna Europea*, version 1.3. <http://www.faunaeur.org/> [accessed 28.VII.2008]
- Telnov D, Bukejs A, Gailis J, Kalnins M, Napolov A, Sörensson M (2007) Contributions to the Knowledge of Latvian Coleoptera. 6. *Latvijas entomologs* 44: 45-52.
- Thomas MC (1993) The Flat Bark Beetles of Florida (Coleoptera: Silvanidae, Passandridae, and Laemophloeidae). *Arthropods of Florida and Neighbouring Lands*, Volume 15. Florida Department of Agriculture & Consumer Services, Gainesville, 101 pp.
- Thomas MC (2002a) Silvanidae Kirby 1837. In: Arnett RH, Jr, Thomas MC, Skelley PE, Frank JH (Eds) *American Beetles*, Volume 2: Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press, Boca Raton, 322-326.
- Thomas MC (2002b) Passandridae Erichson 1845. In: Arnett RH, Jr., Thomas MC, Skelley PE, Frank JH (Eds) *American Beetles*, Volume 2: Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press, Boca Raton, 327-328.

- Thomas MC (2002c) Cucujidae Latreille 1802. In: Arnett RH, Jr, Thomas MC, Skelley PE, Frank JH (Eds) American Beetles, Volume 2: Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press, Boca Raton, 329-330.
- Thomas MC (2002d) Laemophloeidae Ganglbauer 1899. In: Arnett RH, Jr, Thomas MC, Skelley PE, Frank JH (Eds) American Beetles, Volume 2: Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press, Boca Raton, 331-334.
- Thomas MC (2004) A revision of *Pediacus* Shuckard (Coleoptera: Cucujidae) for America north of Mexico, with notes on other species. Insecta Mundi 17: 157-177 (2003).